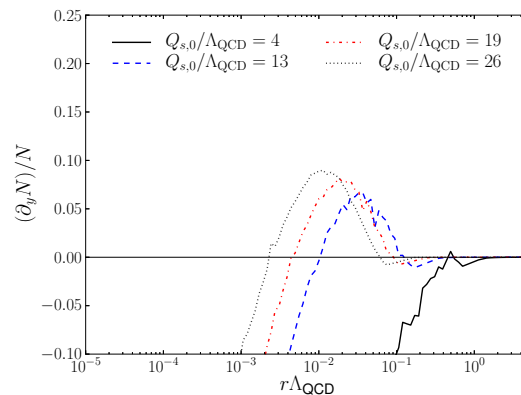


**Comments and
Discussion:**

The Small-x Session

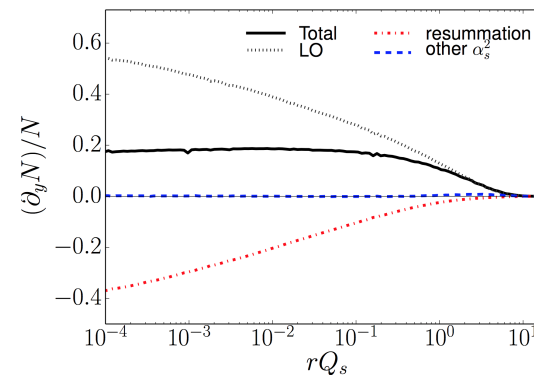
CGC / Small-x at NLO:

“Negative growth” of the dipole scattering amplitude



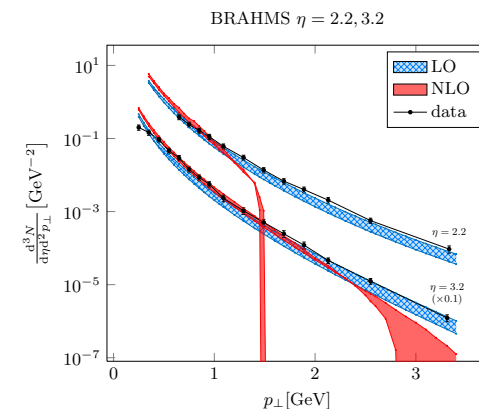
Lappi, Mäntysaari, arXiv:1502.02400

Collinear improvement of NLO BK



Lappi, Mäntysaari, arXiv:1601.06598

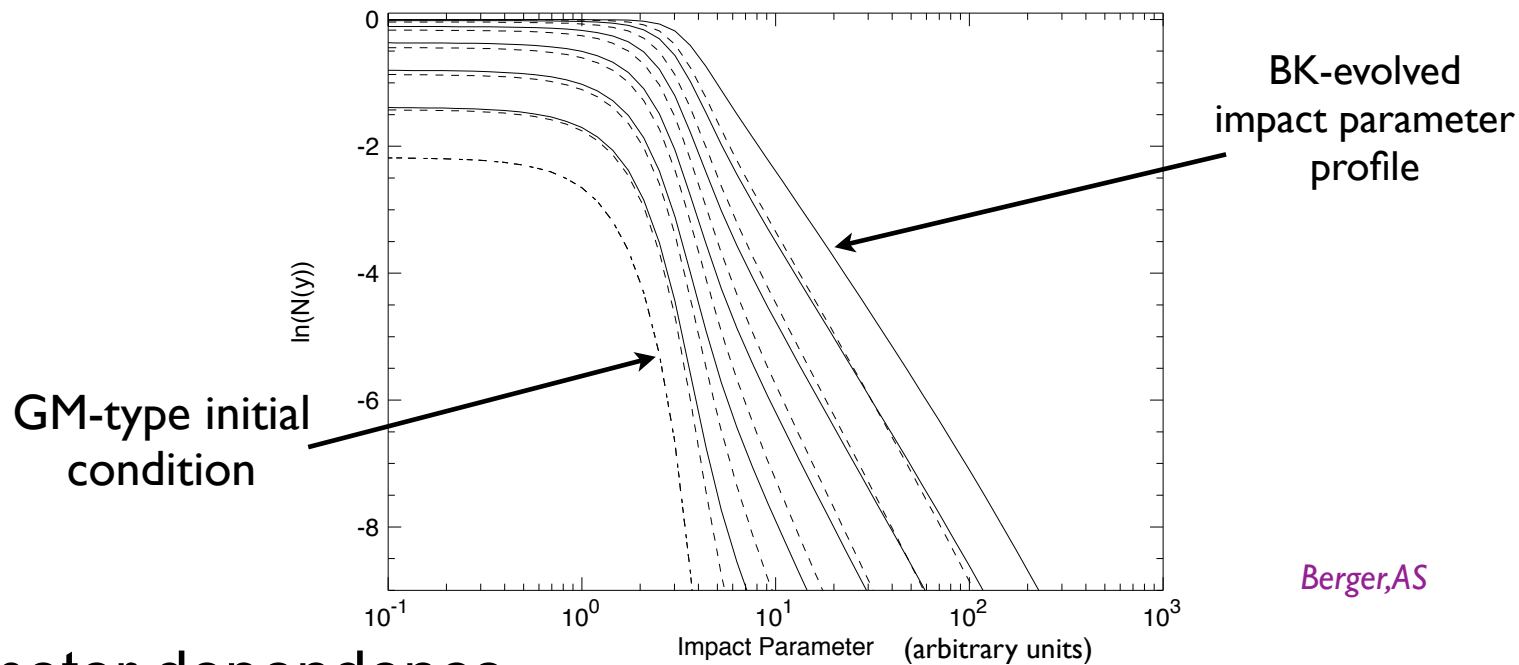
Negative at large p_T



Stasto, Xiao, and Zaslavsky, arXiv:1307.4057

- How under control are small-x calculations, especially in the “hybrid factorization” approach [inclusive and exclusive]?
- It seems like a full set of NLO corrections are now available (impact factors + evolution equations + solutions), but is an NLO calculation sufficient to ensure positivity of the cross-section?
- Is this a symptom that we need to go to NNLO in order to have a reliable description of low- p_T particle production in pA collisions?
- Or is there a defensible way to “bootstrap” the NLO calculation?

CGC / Small-x: Encountering Confinement



- What is the status of impact parameter dependence in the dipole model?

- Have we hit a real theoretical wall related to confinement?

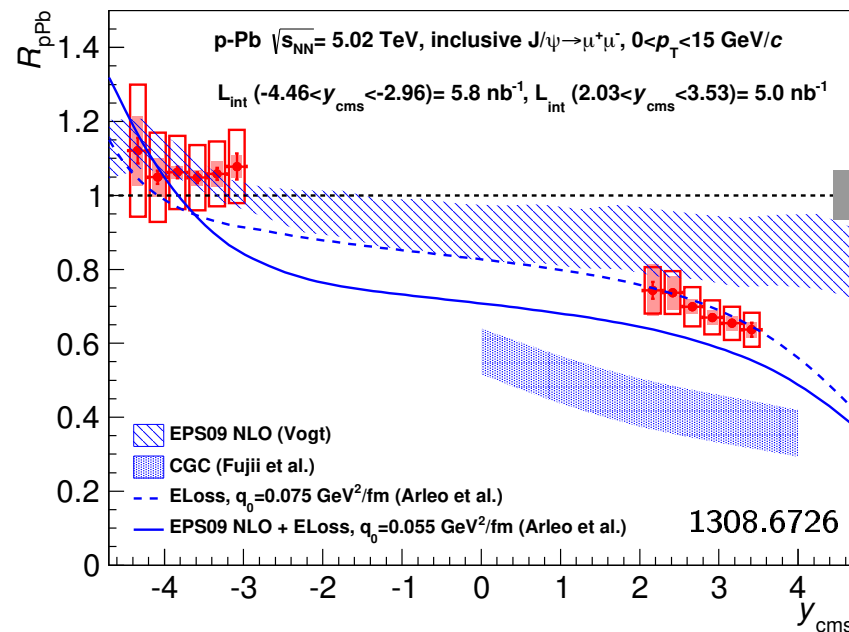
- Does the “effective gluon mass” or hard IR cutoff work adequately? Where / does it fail?

- Are large dipole configurations a real problem?

$$K = dx_{02}^2 \bar{\alpha}_s \frac{x_{01}^2}{x_{02}^2 x_{12}^2} \Theta\left(\frac{1}{m^2} - x_{02}^2\right) \Theta\left(\frac{1}{m^2} - x_{12}^2\right)$$

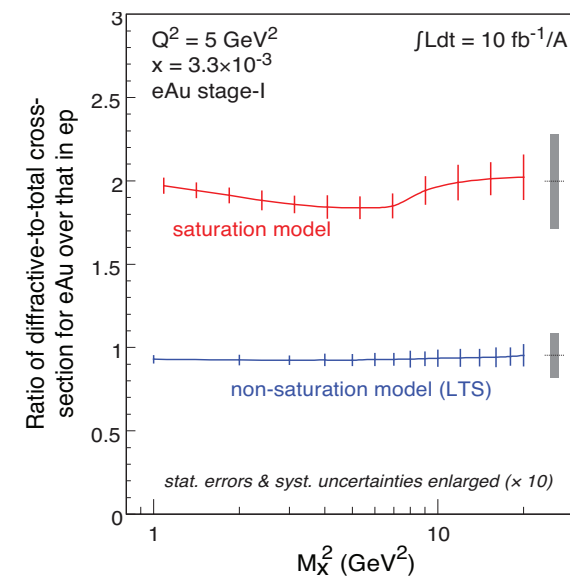
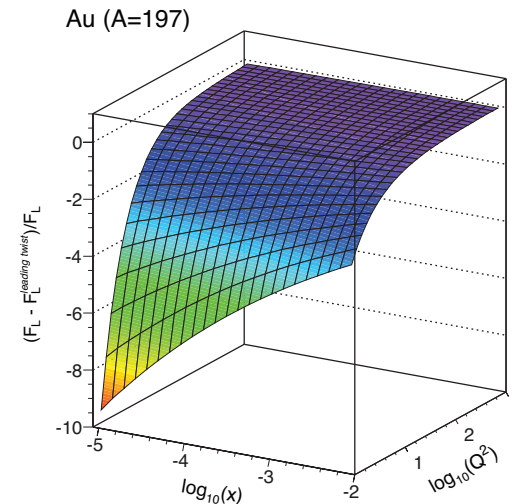
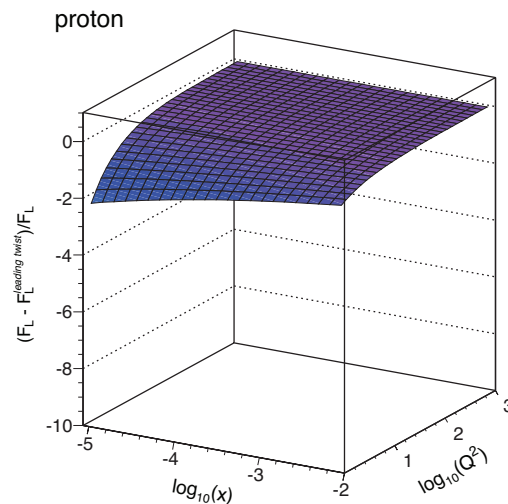
$$V(\vec{b}) = P \exp \left(-ig \int dx^- \frac{\rho(x^-, \vec{b})}{\nabla^2 + m^2} \right)$$

CGC / Small-x: Is R_{pA} for J/psi Meaningful?



- Given current uncertainties about J/psi production mechanisms, is J/psi production (e.g. R_{pA} at the LHC) a useful test of the CGC? Or is it too swamped with theoretical uncertainties?
- The QCD factorization + NRQCD + CGC description of J/psi production seems promising in a number of different channels.
 - Can these newer schemes describe the variety of J/psi channels / properties?
- Are there any additional measurements (say, in pA collisions) which could help add more discriminating power to J/psi production mechanisms?

CGC / Small-x vs Leading-Twist



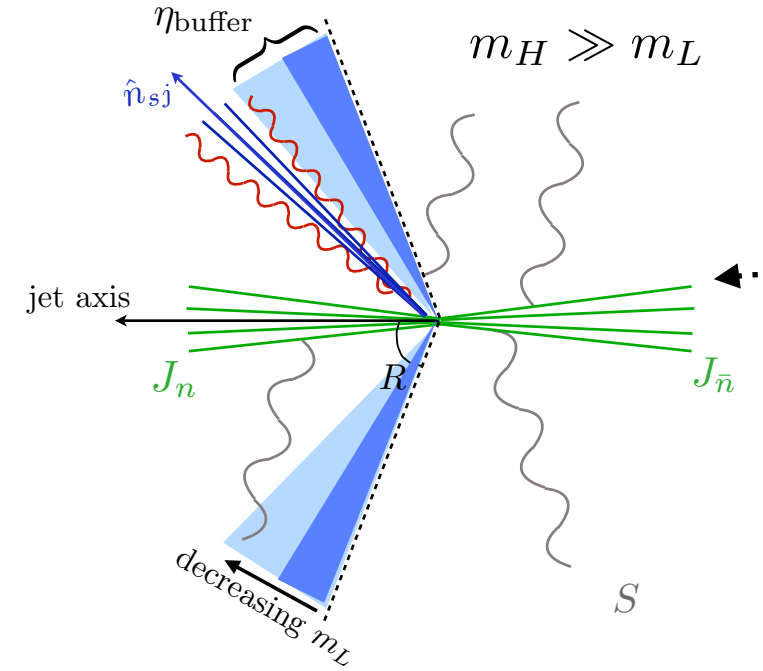
- In current measurements (e.g. diffraction), do we have a clear favoring of “leading-twist shadowing” or other nuclear effects versus saturation?
- Are there measurements where we could / have constrain(ed) the small-x leading-twist behavior at high Q^2 and then go to lower Q^2 to try to enhance higher-twist effects? This is a proposed measurement at the EIC; what do we / could we know / learn about it now?
- What kind of predictions do leading-twist shadowing models give for (de)correlation measurements, e.g. back-to-back dijets? Are there useful comparisons to be made with saturation calculations or energy loss?

CGC / Small-x Duality to Jets?

duality \leftrightarrow

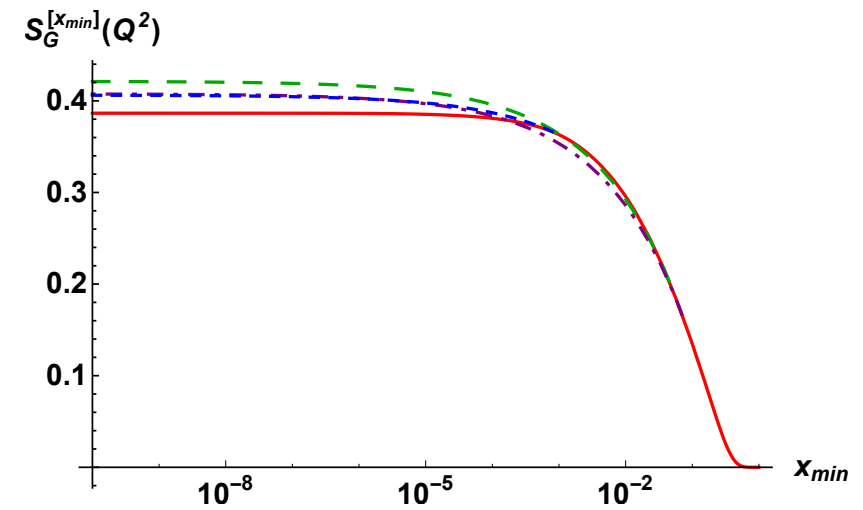
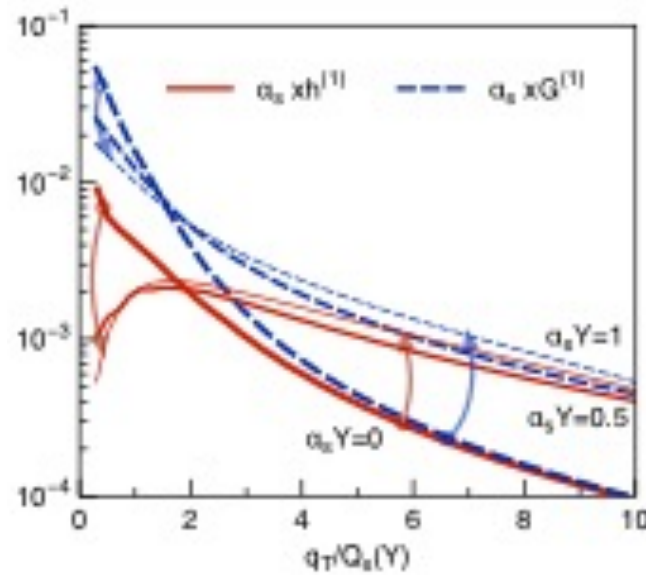
$$\partial_L g_{ab} = \int_{S^2} \frac{d\Omega_j}{4\pi} \frac{a \cdot b}{a \cdot j j \cdot b} \left(g_{aj} g_{jb} - g_{ab} \right)$$

$$\partial_Y S_{\vec{a}\vec{b}} = \frac{\alpha_s C_A}{\pi} \int_{\mathbb{R}^2} \frac{d\Omega_j}{2\pi} \frac{x_{\vec{a}\vec{b}}^2}{x_{\vec{a}\vec{j}}^2 x_{\vec{j}\vec{b}}^2} \left(S_{\vec{a}\vec{j}} S_{\vec{j}\vec{b}} - S_{\vec{a}\vec{b}} \right)$$



- What is the best way to take advantage of the apparent duality between the production of wide-angle radiation in jet physics and small-x evolution?
- Can this duality give some guidance for extending small-x calculations to NNLO or provide other useful “technology”?
- Could this be another related way to test small-x physics?

CGC / Small-x Duality to Jets?



- Are we in a position to robustly describe the polarization state of the CGC in the future?
 - Linearly polarized gluons (small-x vs Q^2 evolution...?)
 - Longitudinally polarized gluons
 - Others: Gluon Sivers function, etc...?
- Can we construct of a **complete small-x description** of the operators / distributions relevant for the proton spin puzzle? (An “asymptotic solution”?)
- What are the evolution equations describing the Jaffe-Manohar OAM? Are any other non-”staple” gauge links important to study?